DATE: July 16, 2002 FILE REF:

TO: Air Toxics Monitoring File

FROM: David Grande – AM/7
Mark K. Allen – AM/7

SUBJECT: Ambient Mercury Monitoring Near Mercury Waste Solutions, Union Grove, April 4 – May 16, 2002.

Project Overview

The Wisconsin DNR shares the use of a trailer equipped with mercury and meteorological equipment with the states of Michigan and Minnesota. Possession of this instrumentation was obtained in early March of 2002, and continued through the end of May. During this period, the two Tekran mercury analyzers were operated first next to each other, to ensure that they were operating properly, and then each analyzer was deployed to a location anticipated to have high ambient levels of mercury. One of these locations was at Mercury Waste Solutions (MWS) in Union Grove, Wisconsin.

MWS is a mercury recycler and reclaimer, recovering between 60,000 and 70,000 pounds of metallic mercury per year from thermostats, gas meters, fluorescent lamp phosphor and other mercury containing materials. It is one of the largest mercury recycling facilities in the nation. The primary emission point is a short seven-inch diameter stack originating in the process room. Sources at the facility indicate it is likely that this stack will be extended in the future to improve dispersion characteristics.

The facility agreed to host the monitoring trailer, not only providing a secure location, but also power for operations. The trailer was parked near the property line to the north west of the stack between April 4 and May 16, 2002. The original location (between April 4 and 10) was on the west driveway. The company's landowner objected to this location, requiring a slight move off the driveway, slightly to the south and west of the original location. A schematic of the plant showing the stack and the monitoring locations is shown in figure 1 below. It should be noted that this figure is not to scale. Locations A and B mark the initial and final monitoring locations, while S indicates the approximate location of the stack.

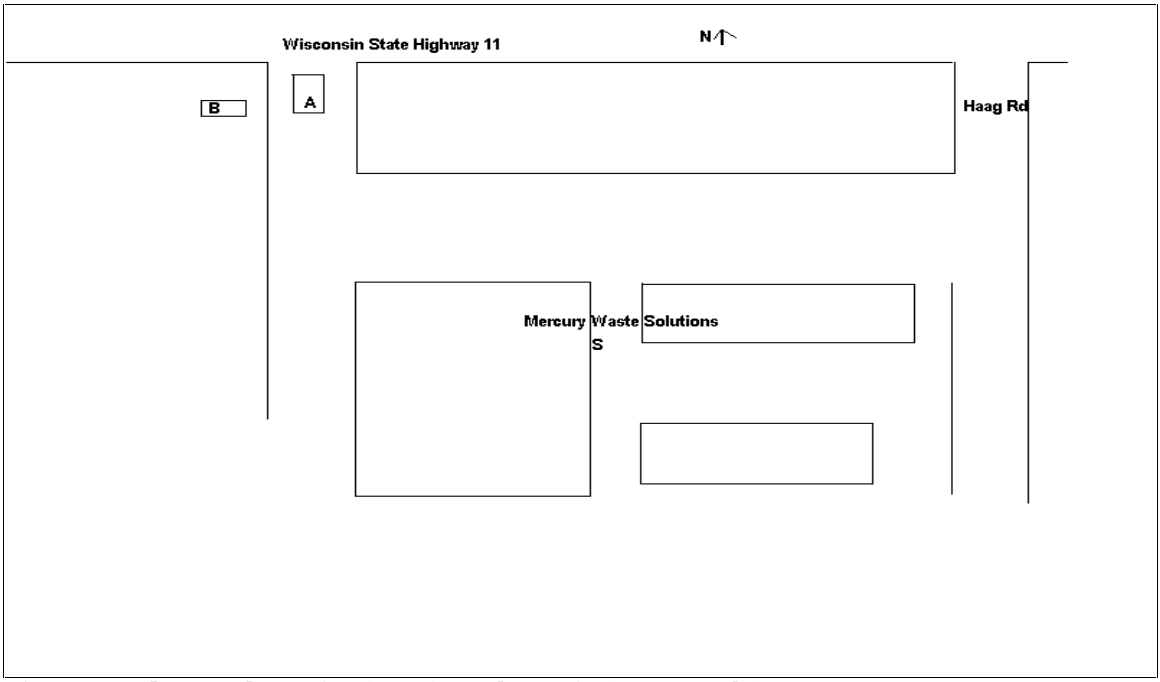

Figure 1: Plant and Monitoring Site Schematic (not to scale)

Equipment and Methodology

Mercury measurements were obtained through the use of a Tekran 2537A Mercury Vapour Analyzer. This instrument collects mercury by drawing ambient air through a cartridge containing a gold adsorbent. The collected mercury is then thermally desorbed and detected using Cold Vapour Atomic Fluorescence Spectrometry (CVAFS). The use of two adsorbent cartridges in parallel allows for continuous sampling of ambient air.

The sampling cycle consists of drawing ambient air over the adsorbent cartridge for 5 minutes, after which a valve switches the sample flow to the second cartridge. The first cartridge is then flushed to remove any unabsorbed mercury in the cartridge and airways, after which it is heated to drive off the mercury and send it to the detector. This protocol therefore provides 5 minute average concentrations.

An internal Mercury permeation source allows for a daily calibration cycle. The calibration cycle includes a clean cycle intended to remove any residual mercury on the cartridges, zero determinations during which clean cylinder air is sampled for the same period as ambient determinations, and span determinations during which air is sampled from over the permeation source. The instrument performs another cleaning cycle before returning to ambient air. The calibration cycle takes 40 minutes to perform in its entirety.

Instrument performance was monitored by the response during the clean and zero cycles and the changes in the response factor calculated from the span values. Major residual concentrations in the zero or clean may be an indicator instrumental contamination requiring action. Sudden major changes in a response factor, or major differences between the two channels may also be indications of instrumental malfunctions.

In addition to the automatic internal calibration, manual calibration checks can be performed. Ideally, this is accomplished by switching the zero cylinder air and ambient sample lines, therefore providing a clean baseline response, and injecting known quantities of mercury vapor during the sampling cycle. The known quantities of mercury vapor are provided by a mercury source, which contains a small quantity of elemental mercury held at a constant temperature in a closed space. A syringe is used to extract an aliquot of air from above the mercury.

Manual calibration checks were performed as described several times throughout the monitoring period. The general rule for acceptable results from this check is ± 20% of the calculated value. A summary of all internal calibrations and manual calibration checks is included in the Quality Control Data section.

A variety of meteorological parameters are collected using equipment manufactured by R.M.Young. Parameters include wind speed and direction, ambient temperature, relative humidity, barometric pressure, solar radiation and vertical wind speed. All parameters are collected as five-minute averages to correlate with the mercury data. In addition to average values, maximum wind speed, maximum and minimum temperatures, and wind direction standard deviation are recorded. All meteorological data is downloaded onto a computer through a communication interface.

All data for the project was routinely downloaded from the trailer computer and stored in computers at the DNR's central office. The data was imported to database and spreadsheet formats for processing and analysis.

Ambient Data

Both mercury and meteorological data was collected in 5-minute averages. These values were then consolidated to provide an overall, as well as hourly and daily averages. Table 1, shown below, presents the overall average, maximum and minimum values observed. Table 2 presents the hourly average, maximum and minimum values, as well as the daily completeness. Table 3 presents the daily average, maximum and minimum values, as well as the daily completeness. A summary listing of the hourly values and the daily values is available in this report's appendixes.

Table 1: Summation of 5 Minute Average Values

Average	Maximum	Minimum	Count
44.0	2579	1.3	9893

Table 2: Summation of Hourly Average Values

Average	Maximum	Minimum	Count
45.5	1135	1.9	861

Table 3: Summation of Daily Average Values

Average	Maximum	Minimum	Count
43.0	165.9	2.6	38

Meteorological data was incorporated to evaluate the differences between winds coming from the facility and those coming from elsewhere. Table 4 shown below presents data evaluated on a cardinal direction basis, with each octant based on ±22.5^{o} of the true direction. For example, the octant labeled "northeast" incorporates all values observed when the winds were between 22.5^{o} and 67.5^{0}. The facility was at approximately 160^{o} in relation to the monitoring trailer. In addition to including the average, maxima and minima observed from each direction, the number of values observed and the percentage of the total values which were from each direction are included. The second portion of the table tallies the number of values occurring in different data ranges. Finally, a percentage of the total values in each of the different data ranges is provided (thus, 7.1% of all values observed were greater than 200 and less than 500 ng/m^3).

Table 4: Evaluation of Results by Wind Direction

Octant	Average	Max	Min	Count	Sector %	>500	>200	>100	>50	50><25	<25	Total
North	4.2	44.5	1.3	1064	10.8%	0	0	0	0	3	1061	1064
Northeast	3.4	129.6	1.6	1102	11.1%	0	0	1	0	0	1101	1102
East	10.4	473.6	1.9	797	8.1%	0	7	5	11	15	759	797
Southeast	166.5	2191	2.9	1326	13.4%	47	411	313	213	110	232	1326
South	141.5	2579	3.1	1224	12.4%	64	277	213	118	95	457	1224
Southwest	7.7	251.1	1.9	2103	21.3%	0	4	0	5	46	2048	2103
West	4.7	221.4	1.5	843	8.5%	0	1	0	1	3	838	843
Northwest	3.5	53.5	1.7	1434	14.5%	0	0	0	1	0	1433	1434
All	44.0	2579	1.3	9893	100.0%	111	700	532	349	272	7929	9893
Percentage of Total Observations						1.1%	7.1%	5.4%	3.5%	2.8%	80.1%	100.0%

This information is shown graphically in the following figure, which illustrates the concentration versus the wind direction. Values plotted are the 5-minute ambient observations. Both the numerical and graphical representations indicate a clear influence of Mercury Waste Solutions on the local ambient mercury concentrations.

Figure 2: Ambient Mercury Concentration versus Wind Direction

Quality Control

Quality control procedures for this study included four types of checks of the Tekran mercury analyzer and the data from that analyzer. The four types of checks include:

- A review of the daily calibration reports.
- Periodic independent verification of the calibration using an external mercury source.
- A review of the analyzer desorption flags.
- Comparison of the two analyzer channels for consistency.

A review of the data found the majority of the data collected between 4/7/02 and 5/16/02 to be valid. Data collected from the time of setup 4/4/02 11:28 until the calibration at 4/7/02 03:15 was recorded but has not been included in the summarized data. During this initial period, the analyzer's response was stabilizing following the set-up. The data was used to check the analyzer's operation but was not included in the summarized data. Missing data between 4/7/02 and 5/16/02 is listed in Table 5. Not included in the table is the time off-line for daily calibrations. The calibration procedure requires the analyzer to be off-line for 35 minutes for each day. The daily on-line time would normally results in a loss of 2.4% of the daily data.

Table 5: Missing data for the project (4/7/02 03:15 to 5/16/02 10:00)

Date of Missing Periods	Ambient Periods Invalidated	Reasons for Invalidation
4/10	3	Analyzer trailer moved from location A to location B. The system was down only for a brief period during the transfer from site power to the trailer's generator.
4/13/02 – 4/16/02	981	Computer locked up and all data was lost until computer restarted on 4/16/02. Time down included a verification of calibration.
4/18/02	2	Power blip caused the analyzer to restart and run a cleaning cycle on each trap.
4/23/02	141	A bad calibration of the "A" channel resulted in the loss of all "A" measurements until the next calibration.
4/25/02	2	Carrier gas cylinder was changed and analyzer restarted. Data was lost during a cleaning cycle of each trap.
4/29/02	12	Verification check
5/2/02	13	Power outage
5/13/02	8	Verification

A final review of the data shows that between 4/7/02 03:15 and 5/16/10 10:00 a total of 9893 / 11353 valid measurements were collected. This is a completeness of 87.1% (this number includes the daily loss of 2.4% for calibrations). When examined on an hourly basis, this translates to 796 hour of valid data. This is based on a requirement of 75% data capture for the hour.

Daily Calibration Reports.

Daily calibrations of the analyzer were automatically conducted at 03:15. The calibration consists of three sample runs on each channel of the analyzer. Runs include a trap cleaning, a zero gas, and a span gas. Following the calibration the instrument prints a report that includes the instrument response factor for each sampling trap. The response factor is then used for the calculation of all results until the next calibration cycle. After the calibration and prior to the start of ambient sampling the analyzer performs a second cleaning run on each trap.

Parameters examined on the calibrations were the zero, the span and the calculated response factor. A summary of these parameters is show in Table 6. The table summarizes the area count and response factors for all calibrations. Overall the data, particularly the mean values, show the data to be very consistent. A graphical time series display of the response factors used to calculate the data is shown in Figure 3. The graph shows that most days the channels show good agreement. On 4/23/02 the response factor for trap A was significantly different from the response factor for column B and from previous response factors. The data collected on column A for this day (from the calibration to the next good calibration) was invalidated, removed, and not used in the data summaries.

Table 6: Summary of Calibration Parameters

	Clean		Zero		Span		Response Factor	
	Column A	Column B	Column A	Column B	Column A	Column B	Column A	Column B
Mean	2368	62794	21810	13763	495255	451276	3649334	3372774
Min	0	0	0	0	423918	343117	3073871	2458944
Max	47884	1345182	271105	244618	1479620	659182	9391757	3523979
StdDev	9704	233784	63557	46591	170252	46516	1004214	168383

Figure 3: Response factors for the Tekran analyzer. Column A is the blue line (dark) and column B the red line (light).

Verifications

The calibration verification is periodically performed to insure that the analyzer internal calibration is accurate. The procedure is described in the memorandum “Mercury Calibration Verifications”. During the project three verifications were performed and are summarized below in Table 7. Three verifications were performed over the course of the project testing both the “A” and “B” columns at two concentration levels (low and high). A fourth verification conducted on 4/29/02 yielded mixed results. When the data from this verification was reviewed it was determined that the inexperienced operator had made an error in the operation of the calibration source. The verification was not accepted for inclusion in the study.

Table 7: Mercury Calibration Verification Summary for Analyzer # 89

Date	Column	Expected. Conc. (ng/M3)	Final Conc. (ng/M3)	Percent Recovery	Pass/ Fail
04/04/02	A	21.75	22.845	105.0%	Y
04/04/02	A	192.67	220.726	114.6%	Y
04/16/02	B	64.01	66.333	103.6%	Y
04/16/02	B	537.85	557.023	103.6%	Y

05/13/02	A	35.79	34.419	96.2%	Y
05/13/02	A	359.81	375.457	104.3%	Y

Data Qualifiers

Each measurement made by the Tekran instrument includes a qualifier called the “desorption flag”. The desorption flag notes any irregularities in the operation of the analyzer during the analysis cycle. Most measurements are assigned an “OK” code. Other significant code reported in the study were “NP”, “M2”, and “OL”. Table 8 summarizes the codes assigned to the ambient data in this project.

Table 8: Data Qualifier Summary			
Assigned Code	Number Measurements	Meaning	Effect on Data
NP	34	No peak detected. This is acceptable for cleaning and zero gas runs. A NP designation for an ambient sample is an indication of a problem.	The 34 measurements were all made on the “A” channel and in the period between 4/4 and 4/6. These were before the start of study data collection. This problem did not occur after 4/6
M2	97	Multiple peaks detected. This can be an indication of a noisy baseline or shoulder peak.	The data was reviewed and determined to be acceptable. Effects were minimal and occurred with no discernible pattern
OL	22	Overloaded trap. These peaks occur when detector signal exceeds 5 mV.	These overloaded values indicate that the actual mercury concentration is greater than the measured value. For summary data the values are treated at the measured value.

Channel Consistency.

The final data examined here is the channel consistency. The Tekran analyzer uses two gold traps that sample alternately. While one trap is sampling air the alternate trap is undergoing desorption and analysis. This arrangement allows continuous sampling of the ambient air. While each trap collects independent samples for analysis, the daily average will summarize 140 measurement on each channel and these average values should be similar. We examined the daily averages for all sampling days of the project. The results shown in Figure 4 show very similar averages on each channel on most days. Larger differences are seen during the initial start-up and on April 23 when the “A” channel recorded a bad calibration.

Figure 4: Time series plot of the daily average mercury by analyzer channel

Conclusions:

The project successfully monitored mercury concentration near Mercury Waste Solutions Union Grove facility. Over a 39-day period from 4/7 to 5/16 over 9800 five-minute measurements were made of the ambient mercury concentrations. The monitoring results show an average mercury concentration of 44.0

ng/M3. This average is similar to the modeled 30-day concentration of 79 ng/M3 (0.079 ug/M3) reported by Jim Fleischmann in his April 15, 1999 report. The monitoring results also present more detailed information on the mercury concentration near the plant. The highest concentrations of mercury are measured from the southeast in the direction of the plant's stack. The average concentration from the southeast is more that 45 times higher that the average mercury concentration from the opposite direction (northwest). The analyzer measured 111 concentration values over 500 ng/M3 with four values over 1000 ng/M3. Limitation of the Tekran analyzers prevented us from monitoring the peak mercury concentration and the highest single value was greater than 2579 ng/M3 (this value overloaded the detector).

While the monitoring project was successful we do recommend additional monitoring especially in the following circumstances

- If any significant changes are made in the facility that may effect mercury emissions. This would include a change in the point of mercury emissions made by moving the location of or increasing the stack height.
- If the DNR should acquire instruments to measure the speciated mercury. In this study, monitoring
- was conducted for elemental mercury and if possible additional monitoring should be conducted to ensure the reactive gaseous mercury. Reactive gaseous mercury (Hg2+) has a greater water solubility and therefore a greater environmental impact that the elemental mercury.
- If any significant vulnerable population is identified near the facility monitoring could be conducted to determine the impact on that population.

CC: Tom Sheffy – AM/7
Ed Miller – SER
Ashok Singh – SER, Sturtevant Service Center
Lauren Hambrook – SER, Sturtevant Service Center

Appendix A: Monitoring Plan

DATE: April 4, 2002 FILE REF:

TO: Tom Sheffy – AM/7
Ed Miller – AM/7

FROM: David Grande – AM/7
Mark K. Allen – AM/7

SUBJECT: Air Monitoring Plan for Mercury Waste Solutions **DRAFT**

Introduction:

Mercury Waste Solutions recovers and recycles mercury from numerous waste streams. Previous survey monitoring employing a portable Lumex monitor has shown elevated ambient mercury concentrations. These results inspired interest by the regional staff in performing more accurate and detailed monitoring, using the equipment time-shared with Michigan and Minnesota.

Contacting the facility resulted in permission being provided to locate a short term monitoring site on their property. Given the short-term nature of the project, the convenience of having a safe location and power provided outweighs the inconvenience of using an on-property site.

Site:

The monitoring site will be located near the northwest corner of the property, along the west driveway as close to the property line as possible.

Monitoring Objective:

Ambient air monitoring will be conducted near Mercury Waste Solutions to determine ambient mercury concentrations associated operations of the facility.

Sampling Schedule:

Semi-continuous monitoring will be conducted from the week of April 1 through the week of May 10, 2002. Measurements will be recorded every 5 minutes throughout this period, with the exception of approximately one half-hour each day during which the instrument runs an auto-calibration sequence.

Methodology:

Analysis will be conducted using a Tekran model 2537A Mercury Vapor Analyzer. The Tekran analyzer uses an automated analysis based on EPA's Method IO-5, **Sampling and Analysis for Vapor and Particle Phase Mercury in Ambient Air Utilizing Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)**. The analysis method begins with the collection of mercury through amalgamation on a gold trap over a preset period (for this project the sampling period will be 5 minutes. The trap is then heated and flushed through a Cold Vapor Atomic Fluorescence Spectrophotometric detector for the determination of mercury. The instrument contains two channels, so that ambient air is sampled continuously. The instrument is capable of part per trillion analyses.

An internal calibration cycle will run each day at a pre-programmed time. In addition to the internal calibration, external calibration verifications will be performed at least twice throughout the project. External calibration verification is accomplished through the manual injection of a measured amount of mercury vapor. The goal in the verification is to recover 80% to 120% of the injected mercury.

Supporting meteorological data will be collected on site, including wind speed, vertical wind speed, wind direction, and ambient temperature.

Data:

All data will be logged on a continuous basis by an onsite computer. The site data will be manually transferred to a desktop computer at the CO and will be stored in an ACCESS database. Hourly and daily arithmetic averages will be calculated and reported.

Cc: Ashok Singh – SER, Sturtevant Service Center
Lauren Hambrook – SER, Sturtevant Service Center
Lloyd Eagan – AM/7

Appendix B: Verfication Protocols

DATE: 4/15/02 FILE REF:

TO: Air Toxics Monitoring Files

FROM: Mark K. Allen – AM/7

SUBJECT: Tekran 2537A Mercury Analyzer - External Accuracy Check

Purpose: To challenge the Tekran analyzer with an external mercury source and demonstrate the analyzer accurate. The goal is to show mercury recovery between 80% and 120%.

Method: The analyzer air inlet is switched to the compressed zero air. The analyzer is allowed to cycle to collect a trap blanks. Following the blank a spike sample is created. The vapor phase mercury above an aliqout of liquid mercury is collected in a syringe and then injected into the analyzer during the sample collection phase. The mercury standard is collected on one of the gold traps along with the air sample. A second blank is collected after the spike. The analysis is by a standard addition technique with the average blank value subtracted from the spiked value.

Mercury Source: The Tekran 2505 Mercury Vapor Calibration Unit contains a mercury reservoir in a temperature controlled block. A septum covers the mercury reservoir and allows aliqouts of vapor phase mercury to be withdrawn in a gas tight syringe. The mircoprocessor in the calibration unit will also calculate the mass of mercury injected onto the trap.

Making an injection: Injections are made with a manual gas tight syringe. The septum wrench is placed on the sampling port to keep the syringe in the correct position for sample collection. The syring is filled in the following manner.

- Insert the syringe into the sampling port
- Purge the syringe by first withdrawing the plunger and then reinjecting the plunger.
- Quickly repeat the purge 6 to 10 times.
- Withdraw the plunger to collect the desired volume of mercury vapor.
- Note the reservoir temperature and the volume of the vapor aliquot (or alternatively use the mass calculation feature of the calibrator to calculate the mass of mercury)
- Remove the syringe and quickly inject the mercury sample into the 2537A analyzer. Samples should be injected during the first 100 seconds of sample collection.

Record the measured mercury on the test trap. Also record the background as the measured mercury blank before and after the spiked sample. The background should be the average of the measured mercury before and after the test trap is spiked.

Calculations: The concentration of mercury vapor in the reservoir is a function of the temperature. The concentration can be determined using equation 1

Eq. 1 $[Hg(o)] = (A/T)* 10 \wedge -(-B+(C/T))$

Where [Hg(o)] is the concentration of elemental mercury in pg/ul
T = temperature in C
A = 3216523
B = 8.13446
C = 3240.872

When the concentration of the mercury is known the amount injected on the trap can be determined by Equation 2.

Eq. 2. pg Hg(o) = [Hg(o)] * ul

The expected concentration is determined by Equation 3

Eq. 3. [Hg(o)] (ng/M3)= Pg Hg(o) / Sampled air volume (L)

To calculate the recovery of mercury

Eq. 4 % Recovery = (Measured – Background) / Expected

Goal: **The goal of this test is to get a percent recovery of 80% to 120%. The analyzer passes the calibration verification if the mercury recovery is calculated within this range.**

Appendix C: Hourly Average Mercury Values

Average Hourly Mercury Concentrations for April 2002
All concentration in ng/M3.

	Hour											
Day	0	1	2	3	4	5	6	7	8	9	10	11
04/07/02				(3.9)	4.2	5.7	5.2	6.0	6.6	6.4	6.3	8.8
04/08/02	5.5	5.9	5.7	(5.6)	6.1	11.5	**489.8**	93.3	395.7	499.4	**623.4**	511.3
04/09/02	3.4	3.2	3.4	(3.2)	2.9	3.4	3.4	4.0	5.3	5.4	6.0	7.5
04/10/02	9.7	6.1	5.1	(4.3)	5.9	27.9	16.1	15.0	(17.8)	35.3	17.6	(19.0)
04/11/02	72.4	102.8	65.0	(11.4)	7.1	5.6	7.5	12.8	13.1	12.0	13.8	14.9
04/12/02	4.6	4.3	4.1	(5.4)	5.6	5.7	5.3	5.5	9.9	7.8	13.6	9.2
04/13/02	3.2	5.1	(2.9)									
04/16/02												
04/17/02	2.8	2.8	3.1	(3.1)	4.5	3.9	3.3	5.2	5.1	5.4	5.1	4.5
04/18/02	199.8	144.3	239.0	(53.3)	484.2	269.4	7.9	12.6	14.5	12.1	11.3	11.4
04/19/02	3.8	2.4	2.6	(2.7)	2.4	2.6	4.1	6.0	5.0	4.8	5.8	6.3
04/20/02	2.2	2.1	2.1	(2.0)	2.0	2.1	2.5	2.9	3.2	3.3	3.2	4.0
04/21/02	2.1	2.1	2.0	(2.0)	2.1	2.3	2.3	2.5	3.0	4.3	6.5	11.2
04/22/02	2.4	2.3	2.3	(2.2)	2.3	2.3	2.5	2.7	3.0	3.5	2.7	2.6
04/23/02	3.4	3.4	82.4	(161.1)	(105.3)	(4.2)	(22.5)	(62.5)	(97.2)	(55.4)	(125.3)	(163.6)
04/24/02	(370.1)	(187.1)	(164.8)	(121.0)	194.2	150.5	54.1	40.7	31.0	26.7	24.2	22.4
04/25/02	2.4	2.6	3.1	(3.3)	2.8	4.8	10.6	10.2	7.9	6.8	6.3	5.7
04/26/02	2.8	3.0	2.9	(2.7)	2.8	4.2	9.0	11.5	8.8	9.7	5.9	9.5
04/27/02	42.5	80.1	168.0	(5.7)	30.7	8.7	6.4	6.2	12.7	22.4	24.9	8.4
04/28/02	100.5	52.0	6.2	(24.7)	7.7	4.6	5.3	5.8	5.6	5.8	7.4	6.4
04/29/02	60.1	113.9	4.0	(4.5)	3.5	3.9	5.1	8.9	13.1	15.0	11.7	(11.9)
04/30/02	2.5	2.7	2.6	(2.5)	2.3	2.5	2.7	2.7	2.7	2.8	2.7	2.8
Day	12	13	14	15	16	17	18	19	20	21	22	23
04/07/02	6.1	5.9	7.1	5.9	5.7	5.3	6.4	5.9	5.3	5.3	5.2	5.3
04/08/02	212.9	8.9	7.6	6.1	5.1	4.1	3.7	3.5	3.3	3.2	3.3	3.4
04/09/02	8.0	13.1	10.8	8.6	69.5	277.9	287.2	**417.1**	367.8	163.6	422.6	118.7
04/10/02	24.1	10.1	26.8	275.9	227.8	162.3	481.0	277.7	193.8	201.6	47.5	188.4
04/11/02	16.7	15.3	15.3	11.5	8.8	7.6	6.5	6.0	4.2	3.7	4.3	4.5
04/12/02	10.5	9.0	8.3	7.7	6.2	5.3	5.7	5.4	7.5	4.6	4.3	4.2
04/13/02												
04/16/02	14.4	9.6	7.1	5.9	4.8	4.6	3.5	3.0	2.6	2.7	2.8	2.9
04/17/02	4.7	4.0	3.4	3.0	2.8	2.7	3.3	10.4	130.0	70.1	230.4	80.5
04/18/02	13.7	12.0	11.5	5.2	6.2	26.4	(4.4)	71.7	8.7	5.7	21.6	14.6
04/19/02	6.7	7.3	5.9	4.6	3.4	2.6	2.3	2.2	2.1	2.2	2.4	2.3
04/20/02	3.7	3.4	3.4	2.7	2.4	2.3	2.1	2.0	2.0	2.0	2.1	2.1
04/21/02	5.1	3.6	3.0	2.8	2.6	2.4	2.4	2.4	2.5	2.5	2.6	2.5
04/22/02	2.8	2.9	2.9	2.6	2.3	2.2	35.1	40.0	220.6	226.6	22.7	3.8
04/23/02	(165.9)	(168.3)	(186.1)	(167.9)	(110.6)	(122.5)	(156.4)	(243.2)	(205.4)	(137.4)	**(1135.3)**	(311.4)
04/24/02	20.6	20.4	17.2	26.8	19.1	7.1	5.4	4.5	3.0	2.9	2.7	2.7
04/25/02	5.5	(5.6)	5.1	4.8	4.2	3.1	2.3	2.2	2.6	2.5	2.5	2.5
04/26/02	6.3	108.3	127.7	77.6	122.1	150.1	240.3	246.5	380.3	385.9	314.5	88.4
04/27/02	9.5	13.2	81.1	61.6	43.6	66.0	83.5	62.1	112.5	141.9	190.1	137.8
04/28/02	7.1	6.6	5.9	4.6	3.9	3.7	3.4	3.3	3.5	3.9	16.4	252.1
04/29/02	(11.6)	4.2	3.7	3.1	2.7	2.5	2.7	2.4	2.4	2.5	2.4	2.4
04/30/02	2.8	2.9	2.9	15.7	239.1	332.5	343.7	207.1	83.0	116.1	22.3	14.6

Bold values indicate at least one of the measurement in the average was overloaded and therefore the value is a minimum.
Bracketed values indicate the average was calculated on less than 75% data capture (<9measurements/hour)

Average Hourly Mercury Concentrations for May 2002
All concentration in ng/M3.

	Hour											
Day	0	1	2	3	4	5	6	7	8	9	10	11
05/01/02	5.0	28.8	8.6	(133.1)	60.3	27.7	6.8	6.0	5.4	7.3	61.9	192.1
05/02/02	2.6	(2.5)	(2.7)	(2.3)	2.2	2.3	3.2	3.2	3.2	3.5	3.8	3.3
05/03/02	2.0	2.1	2.1	(2.1)	2.1	2.6	2.9	3.0	2.8	3.4	6.6	21.5
05/04/02	57.1	161.5	242.8	(282.7)	287.2	265.7	150.2	43.0	11.0	7.2	7.5	15.1
05/05/02	2.8	2.9	3.2	(3.4)	3.2	3.4	3.6	4.1	4.9	6.9	18.5	51.5
05/06/02	2.8	2.8	2.9	(3.3)	3.0	6.1	5.4	5.5	8.6	7.5	8.5	11.9
05/07/02	3.5	3.2	3.4	(3.5)	3.0	3.2	3.1	3.0	3.3	5.2	4.6	4.7
05/08/02	2.2	2.5	6.7	(57.2)	104.6	114.4	168.8	166.9	192.0	160.0	177.7	183.7
05/09/02	385.9	**217.0**	97.0	(6.8)	5.7	3.7	3.0	3.7	4.0	6.8	5.7	4.4
05/10/02	1.9	1.9	1.9	(1.9)	2.0	2.4	2.6	2.7	2.6	2.5	2.5	2.5
05/11/02	**594.0**	282.0	70.5	(6.6)	12.1	62.4	40.1	57.2	55.2	65.7	74.4	30.6
05/12/02	7.3	3.6	3.4	(3.3)	3.0	3.3	4.1	4.3	4.5	4.6	4.1	4.5
05/13/02	2.1	2.1	2.2	(2.2)	2.0	2.1	2.9	6.2	7.2	(6.3)	(4.6)	3.4
05/14/02	2.1	2.0	2.0	(2.1)	2.0	2.7	3.6	4.2	4.2	3.8	3.9	3.9
05/15/02	396.5	351.8	422.2	(97.6)	219.2	137.8	81.1	12.8	9.5	8.6	7.3	7.4
05/16/02	3.1	3.3	3.5	(3.8)	2.9	3.5	4.9	5.1	4.9	4.6		
Day	12	13	14	15	16	17	18	19	20	21	22	23
05/01/02	47.7	6.9	5.9	5.0	3.5	3.1	3.2	3.0	2.8	2.7	2.6	2.5
05/02/02	4.2	2.8	2.5	2.5	2.2	1.9	1.9	2.0	2.2	2.3	2.2	2.1
05/03/02	93.5	71.2	57.7	82.2	51.4	97.1	129.6	136.6	266.5	150.9	149.3	142.8
05/04/02	5.2	5.3	4.8	4.2	3.5	3.0	2.6	87.3	180.5	13.8	3.9	2.8
05/05/02	137.3	133.7	117.1	55.9	47.6	30.0	4.4	183.3	99.2	151.4	4.0	3.1
05/06/02	21.1	8.8	7.1	6.8	6.3	5.4	4.3	5.4	6.4	5.2	3.9	3.4
05/07/02	4.4	4.1	3.8	3.8	3.1	2.5	2.2	2.2	2.2	2.1	2.0	2.0
05/08/02	220.7	218.5	213.9	235.2	235.5	222.6	222.1	212.9	216.9	242.4	236.6	114.9
05/09/02	3.9	3.5	3.3	2.9	2.6	2.2	2.0	1.9	1.9	1.9	1.9	1.9
05/10/02	2.5	2.5	2.5	2.4	2.3	2.1	2.3	25.0	222.8	228.7	202.2	**547.3**
05/11/02	11.9	8.3	9.1	7.1	6.5	5.1	4.7	4.1	4.2	4.3	4.1	7.7
05/12/02	4.3	4.1	3.9	3.6	3.4	2.9	2.6	2.4	2.3	2.2	2.2	2.2
05/13/02	3.3	3.6	3.3	4.3	3.4	2.9	2.1	2.1	2.3	2.8	2.4	2.3
05/14/02	3.6	3.5	3.1	2.8	2.8	2.5	146.1	244.4	109.6	139.3	433.4	403.5
05/15/02	8.0	8.0	6.4	5.4	4.9	3.9	3.6	3.5	3.5	3.4	3.3	3.1
05/16/02												

Bold values indicate at least one of the measurement in the average was overloaded and therefore the value is a minimum.
Bracketed values indicate the average was calculated on less than 75% data capture (<9measurements/hour)

Appendix D: Daily Average Mercury

Daily Average Mercury Concentrations		
Date	Average ng/M3	Count
04/07/02	5.9	241
04/08/02	**124.5**	281
04/09/02	**94.6**	281
04/10/02	99.4	276
04/11/02	18.6	281
04/12/02	6.7	281
04/13/02	3.8	32
04/16/02	4.8	135
04/17/02	24.8	281
04/18/02	70.5	279
04/19/02	3.9	281
04/20/02	2.6	281
04/21/02	3.2	281
04/22/02	25.4	281
04/23/02	**149.5**	160
04/24/02	50.1	261
04/25/02	4.6	279
04/26/02	99.0	281
04/27/02	60.0	281
04/28/02	22.1	281
04/29/02	13.8	269
04/30/02	60.3	281
05/01/02	23.7	281
05/02/02	2.7	268
05/03/02	63.1	281
05/04/02	72.1	281
05/05/02	45.8	281
05/06/02	6.4	281
05/07/02	3.3	281
05/08/02	165.9	281
05/09/02	**33.3**	281
05/10/02	**52.1**	281
05/11/02	**62.9**	281
05/12/02	3.6	281
05/13/02	3.2	273
05/14/02	62.9	281
05/15/02	77.3	281
05/16/02	3.9	114

A count of 281 indicates the average included all possible measurements for the day.

Bold values indicate the average includes at least one measured value that overloaded the trap. The average is therefore a minimum value.